The Northwestern MILLER
MILLING PRODUCTION SECTION

Good Purification Is Essential to Good Milling

By Jack W. Perkins
General Mills, Inc.

JACK W. PERKINS

There is no operation in the mill as neglected as purification, and unwisely so. Study it very closely, for good purification is indeed essential to good milling.

For some time there has been a distinct need to associate the functions of milling with the complete process rather than with individual machines. A tendency seems to be developing to evaluate an operation on the basis of the make of machine used or on the type of accessories applied.

This developing tendency seems to be especially present in certain milling fundamentals. Grinding is associated more and more with what kind of roller mill is used, whether feeders have variable speed, and automatic throw-out devices. Purification tends to be appraised on the brand of machine used, whether it has one or more sieves, made of wood or metal, or if the machine is equipped with a cyclone or filter. Sifting, too, is appraised on a lot of factors other than whether the separations produced are right for the milling process.

This type of appraisal and evaluation is essential. The decisions to replace equipment or to create new models of equipment must necessarily be based on all these factors.

However, appraisal of milling developments and techniques are incomplete if the manner in which machines are applied process-wise is not appraised in detail. The newest and best machine cannot contribute its part to the process unless properly applied and supported by other operations.

Therein lies a hazard to the miller. If he permits himself to appraise an operation, without due consideration of the process and principles of operation, he is likely to conclude he can do nothing without new machines.

He may not actually do all he can with what he has. He may not select the besh machines for his process when that time comes.

Put Thought Into It

Consider purification in this light: Machine builders will supply more and more improved machines as demands present themselves, and details of engineering and installation will be resolved by examination of the individual machine's requirement. However, the miller, in his planning machines into the process or in maintaining the process, controls the ability of the machine to pay off in improved results.

So, put a little milling thought into the matter of purification.

The function of the air purifier is to provide as pure a middling to the gradual reduction system as is practical. A secondary function of the purifier is to further grade the particles to the advantage of the roller mill for further reduction in particle size.

This definition of the function of the purifier applies whether the machine proper is of the latest development or is one that has been operated for the past couple of generations.

The second fact of purification is that it remains simply a separation between the pure and impure material. The principle used in accomplishing that separation, or any separation for that matter, is or should be based upon the greatest dissimilarity of the pure and impure.

On this basis, the newest of purifiers represents only refinement—not revolution. Basic principles of separation are unchanged. Yet, the new machines represent refinement to a significant degree.

Still, no matter how high the degree of refinement, the secret of making a machine pay off is in using it right. This means proper understanding of its place in processing must go into application. Proper operation must be continued after it has been applied.

So, with this as a basis for consideration of purification, the approach to improved purification remains basically the same whether new machines are installed or old systems renovated.

Requirements

What, then, are the requirements of good purification?

1. Good Breaking. Break rolls must be in good condition. They must produce a maximum release through scalps with a minimum production of fines. The type of corrugation is important. Spiral is important. But most important of all is that the right number of corrugations in good condition are working on the break stocks.

Want to improve your purification? Look at your breaks.

2. Good Bolting. Bolters supplying graded stocks to the purifiers must be operating correctly. They must be properly engineered to their load so that stocks are well bolted. Sieves must be in good condition, clothing must be intact. If condensation is present, the problem must be solved.

Floury grading from the breaks to purifiers represents a loss to dust collectors, thence to feed or a lower grade of flour. Besides, the purifier proper is handicapped due to improper feed material.

Want to improve your purification? Look at your break and grading sifters.

3. Good Classifications. Accurate classifications are a must for good purification. Many classification factors can affect ability to do a job on the purifiers. The "substitute" cloth put on when an emergency arises ("go ahead and use that 68 wire, we'll change it out next week when our 75 wires get here"); grinding balance among the breaks supplying the purifiers; selection of clothing sizes; splits to sifters — all these things affect major purifier classifications.

Want to improve your purification? Take a good, close look at your classifications.

4. Balance. Mill balance is an obscure thing to describe. Still, it is most important to acceptable purification. Mill balance is the combination of machine arrangement, machine settings, machine condition,

(Continued on page 21a)

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CHEMISTRY OF LEAVENING

By **John R. Van Wazer and Peter G. Arvan**

Monsanto Chemical Co.

PART I

A chemical leavening system may be defined as a composition of matter which, when contained in a batter or dough, is capable, under proper conditions of moisture content and temperature, of releasing a gas. The gas, via expansion, serves to increase the volume of the entire mixture, thus resulting in a porous baked product.

The gas most commonly used to accomplish the desired expansion of batter or dough is carbon dioxide. Although other gases, such as ammonia, nitric oxide, oxygen, air, steam and nitrogen have been used, their application has found only limited acceptance.

Generally, a leavening system is composed of three types of materials: (1) a carrier of carbon dioxide, (2) a leavening acid, and (3) a diluent or filler.

The carrier of carbon dioxide most frequently used is a metal carbonate or bicarbonate salt, the most important of which is sodium bicarbonate (soda, bicarbonate of soda), $NaHCO_3$. Other carbon dioxide carriers are acetone dicarboxylic acid, ammonium carbamate, ammonium carbonate, ammonium bicarbonate, and other metal hydrogen bicarbonates.

Since practically all chemical leavening systems contain sodium bicarbonate, the discussion here will be centered about this carrier of carbon dioxide.

The release of carbon dioxide from a carrier can be accomplished either by heating and/or by reaction with acids. The loss of carbon dioxide from carriers via the thermal decomposition route can be represented by the following equations:

$$NH_4HCO_3 + \text{heat} \rightarrow NH_3 + H_2O + CO_2\uparrow$$
$$2NaHCO_3 + \text{heat} \rightarrow Na_2CO_3 + H_2O + CO_2\uparrow$$

The reactions resulting in the release of carbon dioxide by action of leavening acids on carbon dioxide carriers are discussed below. In the case of soda, a high temperature is needed for thermal decomposition, so that little, if any, of the carbon dioxide is released by the thermal step, but rather by the reaction with acid.

The leavening acid portion of chemical leavening systems serves to initiate and sustain the release of carbon dioxide gas from a carbon dioxide carrier. Metal carbonates and metal bicarbonates, when brought into contact with an acid in an aqueous or moist medium, will give carbon dioxide as follows:

$$M_2CO_3 + 2HX = 2MX + H_2O + CO_2\uparrow$$
$$MHCO_3 + HX = MX + H_2O + CO_2\uparrow$$

Leavening Acids — Some of the more important leavening acids which are in commercial use today are:

Chemical name	Chemical formula	Letter abbrev.
Monocalcium Phosphate Monohydrate	$Ca(H_2PO_4)_2 \cdot H_2O$	MCP·H_2O
Monocalcium Phosphate Anhydrous	$Ca(H_2PO_4)_2$	MCP
Sodium Acid Pyrophosphate	$Na_2H_2P_2O_7$	SAPP
Sodium Aluminum Sulfate	$Na_2SO_4 \cdot Al_2(SO_4)_3$	SAS
Potassium Acid Tartrate	$KHC_4H_4O_6$	——

It should be noted that the compounds listed above are not usually considered acids in the normal chemical sense of the word. These materials are actually metal salts of partly neutralized acids (acid salts), as in the case of monocalcium phosphate, potassium acid tartrate, and sodium acid pyrophosphate, or are materials which react with water to liberate acids, as in the case of sodium aluminum sulfate:

$$Na_2SO_4 \cdot Al_2(SO_4)_3 + 6H_2O = Na_2SO_4 + Al_2O_3 \cdot 3H_2O + 3H_2SO_4$$

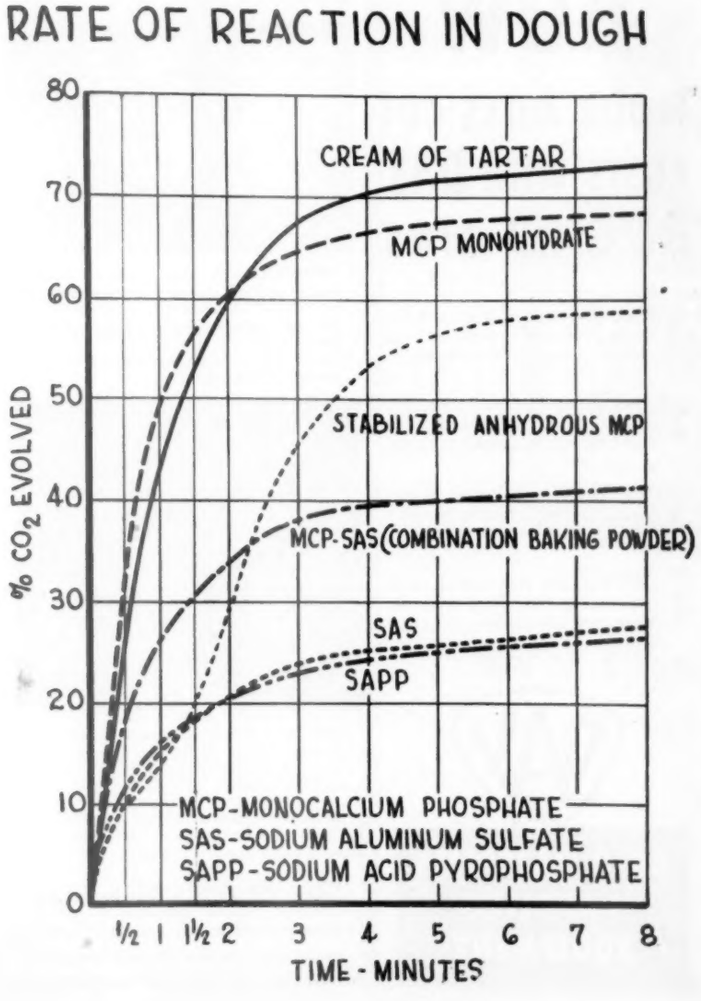
Liquid acidic materials, such as phosphoric acid (H_3PO_4) and sulfuric acid (H_2SO_4), etc., are not acceptable as leavening acids because of the difficulties involved in incorporating the liquid phase into the system. Further, such materials (strong mineral acids) are much too reactive toward carbon dioxide carriers. This high reactivity would result in a leavening system which would lose its carbon dioxide content almost immediately after preparation.

Organic acids and their derivatives, such as tartaric acid and gluconodelta-lactone, have been used as leavening acids. These materials, however, when employed in chemical leavening systems are almost always utilized in combination with one of the five major acids listed above.

Leavening acids may be classified into two general categories. The first are called "fast acting," since they react with a carbon dioxide carrier as soon as liquid (water or milk) is added to the dough mixture and consequently prematurely liberate a large portion of the available carbon dioxide. The other class embodies the "slow-acting" acids, which liberate most of the available gas in the dough during the heating period. Larger and lighter baked goods are obtained when "slow-acting" leavening acids are used.

Rate of Reaction—The rate of reaction of a leavening acid is defined

EDITOR'S NOTE: This is the first of two articles on chemical leavening systems. The second part of this explanation of the chemistry of leavening will appear next month. Dr. Van Wazer is assistant director of research for the Monsanto Chemical Co.'s inorganic chemicals division. He also is in charge of the food technology laboratory operated by the division at Dayton, Ohio. He is recognized as an authority in rheology and is the author of many papers on that subject as well as on phosphates. Dr. Arvan is a group leader in the research department of the inorganic chemicals division at Dayton. He has done considerable research in the food field and is the author of several previous papers on the subject of phosphates.



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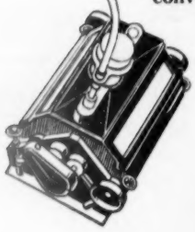

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as the rate at which carbon dioxide is evolved over a period of time when a given amount of acid leavening reacts with a fixed amount of sodium bicarbonate in a dough mixture under specified conditions.

In determining rates of reaction, a special apparatus[2] is used which consists essentially of (1) a small reaction vessel or bomb equipped with a mechanical stirrer; (2) a water bath maintained at a constant temperature; and (3) a gasometer connected to the bomb for measuring the volume of carbon dioxide evolved.

Operation of the apparatus consists of (1) placing weighed amounts of flour, salt, skim milk, shortening, soda and leavening acid in the bomb; (2) connecting the bomb to the reaction rate equipment; (3) admitting the proper amount of water to the bomb; and (4) reading the gasometer for volume of carbon dioxide evolved after various lengths of time.

The volume of carbon dioxide evolved is expressed as percentages by weight of the amount theoretically available from the soda. The percentages of carbon dioxide may be plotted as a function of time, which gives a curve characteristic of the particular leavening acid tested. Curves characteristic of the more common materials are shown in the accompanying graph. It should be noted that tartrate and MCP monohydrate have steep curves; hence they exhibit relatively fast rates of reaction. By comparison, slow-acting SAPP and SAS have slow rates of reaction.

As it is not always convenient to talk in terms of curves, the rate of reaction of a material is frequently referred to for a stated reaction time. If the time is omitted, it is implied. Reaction rate ranges for several Monsanto leavening acid materials at the usually stipulated reaction time are as follows:

Material:	Reaction time (minutes)	Rate of reaction (% of total CO_2)
SAPP-28 (slow-acting)	8	26-29
SAPP-40 (fast-acting)	8	39-40
MCP—anhydrous	2	23-25
	10	72-74
MCP—monohydrate	2	56-59
	8	64-69

Ranges shown for rates of reaction apply to several variations in type of product. For instance, the range given for MCP monohydrate includes both the spray-dried and granular products. In addition to the differences due to variations in the leavening agents themselves, it should be noted that the rate of reaction is not a precise measurement. Thus, it is not uncommon to obtain variations of as much as 2% of carbon dioxide on individual samples of the same batch.

Leavening Systems—The diluent in a chemical leavening system serves to separate the carbon dioxide car-

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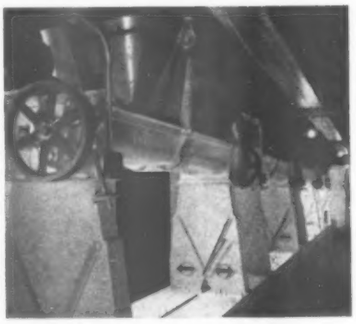

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rier from the leavening acid in order to prevent premature reaction (and thus the liberation of carbon dioxide) before the leavening mixture is incorporated into the moist dough and baked. The diluent further retards chemical reaction by coating the individual particles of the carbon dioxide carrier and/or the leavening acid.

In addition to its role of preventing premature reaction by separating the reactants, the diluent may further serve as an equalizing or standardizing agent. Thus, in baking powders it is added to each type of leavening system in such a quantity that given amounts of the diluted leavening system will yield specified amounts of carbon dioxide. If the quantity of carbon dioxide generated by a definite weight of a baking powder were not somewhat standardized, there would be even greater difficulty encountered when one type of leavening system was substituted for another in a recipe than is now found by replacing a fast- with a slow-acting baking powder or vice versa.

The most commonly used diluents or fillers are cornstarch and flour. In recent years, precipitated chalk (calcium carbonate) has found some acceptance because of its low cost, even though it is not as efficient a separating agent as cornstarch. The precipitated chalk, because of its relative chemical inertness, does not serve as a major source of carbon dioxide.

When a small amount of diluent (starch) is used and the amount of carbon dioxide carrier plus leavening acid is present in the system in relatively high amounts (60-70% of the total), the mixture is known as "baking powder," which is only one of the several ingredients required to obtain a complete baking dough.

Self-Rising Flour, Mixes

Following this scheme of classification one can say that, when wheat flour is used as the diluent, the resulting mixture is known as either a self-rising flour or a prepared mix.[1] The concentration of the carbon dioxide carrier plus the leavening acid in this type of system is quite low (2-5% of the total) as compared to a baking powder formulation. A self-rising flour is usually composed of the flour, salt, leavening acid, and carbon dioxide carrier. The prepared mix, however, is a more complete baking mixture, containing all or nearly all of the necessary ingredients, such as fat, dried eggs, sugar, nonfat milk solids, etc. Usually, only water need be added to a prepared mix in order to achieve a complete dough ready for baking.

It is important that the amounts of sodium bicarbonate and leavening acid used in the preparation of a baked product be in such proportions that after baking there remain little, if any, unchanged reactants in the finished product. In general, a baked product in which the proper balance of soda and leavening acid has been used, will give an essentially neutral (pH 6.5-7.5) reaction when slurried with water.[2]

An excess of soda over leavening acid will impart an alkaline reaction and also cause a yellowing of the normally white interior of the finished product. An excess of phosphate leavening acid over soda will give an acidic product, with heavier cell walls and lighter crumb color.

If the phosphate leavening acid is too coarse, it will form charred specks in the crust, indicating localized excess of acid. This charring or blackening is related to the flameproofing action of materials releasing phosphoric acid.[3] Acidic phosphates catalyze the thermal decomposition of cellulose, so that a large amount of char and little gas are evolved.

It was for the purpose of obtaining first-order approximations of the amount of soda to be used with various leavening acids and also for the purpose of comparing and controlling the neutralizing (or carbon dioxide releasing) power of leavening acids that the concept of neutralizing value was developed.

Neutralizing Value—The neutralizing value of leavening acids may be defined as the parts by weight of sodium bicarbonate from which 100 parts by weight of leavening acid will release all available carbon diox-

Installing Leather Belts

In forcing an endless leather belt over pulleys, avoid putting a crook in it. Belts, particularly those 6 in. and wider, should either be made endless on the job by means of clamps and rods or slipped on after the center distance between pulleys has been temporarily shortened.

Field splices of double ply belts are sometimes made in the same manner as those of single ply belts. This type of a splice is somewhat easier and less costly to make than the one generally regarded as standard. While it is satisfactory for many jobs, it may result in a somewhat weaker and stiffer joint.

Care should be taken to have the outside feather edge of the lap faced away from the direction in which the belt runs. This tends to protect the outside points of the lap if they should strike guards, guides or shifters. In addition, this arrangement keeps the lap from being opened by windage.—**From the Power Transmission Council, reprinted from Plant Engineering.**

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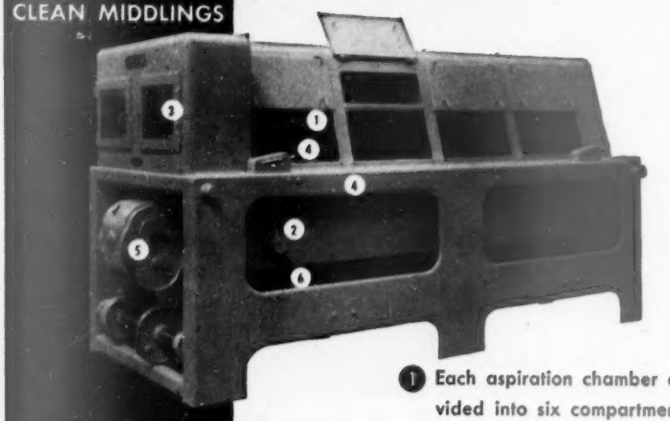

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ide. The following example illustrates the neutralizing value concept:

Reaction weights: 188 84

$$KHC_4H_4O_6 + NaHCO_3 = KNaC_4H_4O_6 + H_2O + CO_2$$

In this case, 188 units of potassium acid tartrate (cream of tartar) will completely release the carbon dioxide from 84 units of sodium bicarbonate. Therefore, 100 units of $KHC_4H_4O_6$ will completely release the carbon dioxide from 100/188 as much soda, or 45 units. The "theoretical" neutralizing value of cream of tartar, therefore, is 45.

In order to calculate the theoretical neutralizing value of any leavening acid, one must know all of the products and the quantitative extent of their formation, from the reaction between the soda and the leavening acid. Since such complete knowledge is not always available, and also because the purity of the acid is not always known, experimental determinations of the neutralizing value are carried out. Such methods, although highly empirical in nature, do serve to give results which can be correlated with actual baking practice. The experimental determination of the neutralizing value of a particular leavening acid is also useful as a method of estimating the strengh and purity of the leavening acid.

Experimental methods used for the determination of the neutralizing values of monocalcium phosphates and sodium pyrophosphate are described in detail in the Cereal Laboratory Methods of the American Association of Cereal Chemists.[1] In Monsanto practice three procedures are employed for the experimental determination of the neutralizing value of calcium phosphate leavening agents. Test A consists of a simple titration of the leavening agent to a pink phenophthalein endpoint (about pH-8) with 0.1N NaOH. The solution resulting from test A is then boiled for one minute so as to discharge the pink color, and then the hot solution is again titrated with 0.1N NaOH to the pink endpoint. This is the B test, which is considered as the standard method for calcium phosphates, and is described in the above reference. In the C test, an excess of NaOH is used, and the highly alkaline solution is boiled for one minute before it is titrated, while hot, with 0.2N HCl to an endpoint consisting of a discharge of the pink phenophthalein color. In test A, monocalcium phosphate is converted primarily to dicalcium phosphate, whereas the main product in tests B and C is hydroxylapatite. For this reason, about 12% less NaOH is used in test A than in the other two tests.

In the case of sodium acid pyrophosphate leavening agents, the neu-

(Continued on page 20a)

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AOM COMMITTEES—Members of three national committees of the Association of Operative Millers met recently in Minneapolis to continue work on major projects of the association. Shown in the picture on the left are members of the education committee. Left to right are Jack W. Perkins, General Mills, Inc., Minneapolis; Eugene Farrell, Kansas State College, Manhattan, chairman; Arlin Ward, Pillsbury Mills, Inc., Minneapolis, and Arthur Hibbs, International Milling Co., Minneapolis. The picture in the center shows members of the technical committee at work. Seated, left to right, are Dewey Robbins, Fisher Flouring Mills Co., Seattle; George Tesarek, Quaker Oats Co., St. Joseph, Mo., chairman; Lyle Mertz, General Mills, Inc., Buffalo; R. R. Brotherton, Bay State Milling Co., Winona, Minn.; George S. O. Smith, Flour Mills of America, Inc., Kansas City. Standing, left to right, are G. M. Kautz, Lauhoff Grain Co., Danville, Ill.; R. C. Bradford, Pillsbury Mills, Inc., Minneapolis; E. S. Dybevick, International Milling Co., Minneapolis; Ben Blackburn, Fant Milling Co., Sherman, Texas; Fred Atkinson, Atkinson Milling Co., Minneapolis. In the picture on the right are members of the sanitation committee. Left to right are Harold Goossens, Russell-Miller Milling Co., Minneapolis; D. A. Wilbur, Kansas State College, Manhattan; George Wagner, Pillsbury Mills, Inc., Minneapolis, chairman; William Schoenherr, Lauhoff Grain Co., Danville, Ill.; Paul McSpadden, Commander-Larabee Milling Co., Minneapolis. These AOM committees meet three times a year and annually hold one of the meetings in Minneapolis.

The Art of Good Feed Mixing

By Archibald McClure

Quaker Oats Co.

EDITOR'S NOTE: The complex job of modern feed mixing and some of its problems are described in the accompanying article. To remain competitive and at the same time make a uniform, well mixed feed incorporating the many new developments, a feed miller must be a real "artist." The author of the article is the superintendent of the Memphis feed mill of the Quaker Oats Co. The article is from a talk given by Mr. McClure at a meeting of the Association of Operative Millers.

FIFTEEN years ago, the novelty of vitamins in the human diet was just wearing off, antibiotics was a word that stumped the spelling bee finalists, and the wonder drugs of today were fantasies. Chickens devoured four or more pounds of feed for every pound they gained; good egg layers produced perhaps 180 eggs per year.

Today with the new high energy broiler feeds, chickens require only 2½ to 3 lb. feed per pound of gain, and good layers produce up to 240 eggs per year. Preventive drugs in mixed feed diets now help to control diseases before they develop instead of waiting to cure them after an outbreak. Pigs eat less feed and gain much faster. The story is the same with beef cattle and dairy herds.

There are many answers for these astounding results. The key to it is the emphasis that all the people concerned have put on the subject of feed in the past 15 years. A recent cartoon typifies this emphasis very clearly. Two women are pictured looking over a huge baby food display in a grocery store, with a banner announcing that the baby food is now "mineral-enriched." One lady says, "I'm sure glad they're finally making enough of those drugs they've been feeding the cows that they can give some to the children."

Research and sales, both of chemical companies and food concerns, have accomplished a tremendous job in increasing the efficiency of livestock's food-producing machinery and educating the farmer in better methods of controlling this machinery.

The middle man between the developers of these new feeds and ingredients and the consumers is the feed miller. He has had to adapt antiquated flows, machinery and attitudes to a flexible, fast-moving, critically-controlled production system. Both the miller and the machinery suppliers have done an outstanding job in the meeting of these new challenges.

Putting Materials Together

Basically, the art of good feed mixing is the exact reverse of the rest of the milling processes. It is a problem of putting materials together rather than extracting products from other materials. Flows, problems and equipment are similar to those in flour, corn and soybean mills, the by-products of which constitute the major components of mixed feeds. In feed milling, however, first consideration is always given to the effect of any process on how the finished product is mixed. In flour and corn milling, the main consideration is to extract as much flour and meal as possible on a yield basis and maintain the quality required. In feed milling, the miller strives to control the use of all the ingredients so as to blend them together uniformly and meet the analysis guarantee, at the same time using the minimum necessary amount of the high-priced materials.

A second basic consideration in feed milling is the necessity for flexibility. In general the more competitive companies today with complete lines of products have from 40 to 60 different feeds packaged in 80 to 150 different packings. It is quite remarkable that the salesmen manage to keep up with such a line, considering the many changes as new developments occur. Even the miller has to think fast to be sure he is up-to-date on all the feeds himself.

To make these feeds requires from 40 to 50 different ingredients and from 5 to 15 various chemicals—any or all of which have recently been changing as rapidly as the feed formulas. Not only must the miller anticipate his requirements of each of these ingredients from week to week, but he must be thoroughly acquainted with the appearance, texture, handling qualities and feeding importance of each. He must know when you can and when you can't change an ingredient. Chickens eat by color. A change from a dark to a light gluten or alfalfa in a feed might cause a flock to stop eating. Various grades of grains must be milled separately or blended. Some grains are ground on several size screens, then binned and used separately. An understanding of each ingredient is essential to insure uniform, well-mixed feed.

Scheduling is usually on a day-to-day basis with over-all purchasing and production planning geared to monthly or weekly sales estimates. Generally the miller will not know until noon what he is expected to make the next day. Because ingredient prices can vary so rapidly and to such extremes, floor stocks of ingredients and finished feeds should be kept to a minimum. Most of the feed miller's materials can not be hedged as completely as in a corn or flour mill.

It is, therefore, necessary to make 20 to 25 different feeds every day on the mixing lines. When you consider each change involves from 10 to 25 different ingredients, the need for close control is readily apparent. Human error in properly adjusting any of 300 to 500 feeder settings a day is extremely easy. As a result, much emphasis has been placed on proper control of feeders.

You are undoubtedly familiar with the general operations of a feed mill, but it might be worthwhile to review briefly what happens on one of these feed changes. Let's assume we are making a chicken feed on a mixing line and we want to change to a dairy feed. It is essential in this particular change we are discussing that some of the drugs and certain of the ingredients of the chicken feed do not get into the dairy feed, because the drugs might kill some of the essential rumen bacteria in the cow or the smell of some ingredient might keep the cow from eating the feed and throw it off production.

There are two main types of feed mixing systems: (1) The continuous, where all the feeders run into a mixing conveyor, and (2) the batch system, where the proper amount of each ingredient is weighed into a tank and then mixed in batches.

A continuous mixing line will have from 15 to 30 feeders for the principal ingredients, depending on the formulas and number of bins allocated at a plant for each ingredient, and from one to 10 feeders for chemicals. Most lines will run between 15 and 30 tons per hour depending on the size and design of the plant. The basic problem in making a change is to start with the first feeder on the line and walk down the mixing line at the same rate as the feed is moving through the system, changing the feeder settings or cutting feeders in or out as the formula specifies. If the feeder man adjusts the feeders at the proper rate, there will be a minimum of mixture of the old feed and the new feed which must be "set back" by the packer man until the new feed has reached the packer. The man must also adjust each feeder properly and cut in the proper ones so that the new feed will meet requirements.

Most mills have quality control men who check in behind the feeder man to see that he sets feeders correctly on every run. A laboratory analysis on every batch of feed is made as a double check to be sure it is properly mixed. Ingredient usage records are compared closely with formula usage requirements as a third control on feed quality, especially on the critical drug items. On each change some time is lost and a few bags of mixed up feed are "set back" until the appearance of the new feed is correct and it is okayed to pack. It is important to keep changes to a minimum, from a production as well as quality standpoint. On changes such as outlined above it is essential to control the disposition of the "set backs" which are fed back slowly into the mixing lines so as not to lose the material. The drug feeds can not be remilled into the dairy feeds, and vice versa.

Mechanical Controls

Much progress has been made by the millers and machinery manufacturers to reduce the chance for human error by mechanical controls. Many types of indicators and semi-automatic feeder units have been developed. Mixing accuracy is essential, but not as critical as in some processes. Volume type feeders are, therefore, adequate but are being replaced by new weight type units for closer control, especially of critical and of high cost items.

Each feeder is tested out on each feed run to see that it is set correctly. Further watch is required, however, during the run to be sure each of the ingredients has a uniform appearance. (They are all checked by sample upon receipt.) Constant checks of the milling streams from the grain processing machinery are made for proper grind. The miller must see that none of the feeders run empty from lack of supply in the bin, from hanging up in the bin, or caking and lumping. For example, on certain turkey feeds if some ingredient is left out or not correctly fed in, turkeys can develop white feathers, resulting in a price loss to the grower.

Changes on a batch system are less complicated, and controls have progressed further. The most up-to-date batch mixing systems are completely push-button controlled. Ingredients are weighed out automatically or by hand as per formula, conveyed to a mixer where they are

blended from 3-10 minutes, and then conveyed to a packer or bin. Dairy feeds which require more molasses or other liquids that can not be properly added in the batch mixers are further sent through a feeder into a mixing ribbon where the proper amounts of liquids are continuously blended in, and then conveyed to the packer or bins.

Uniform Results

Batch systems tend to be more flexible than continuous systems because of the reduction of changeover problems and because new ingredients are generally easier to add. It is astounding in either method of mixing, however, that such uniform results can be obtained when feed is properly blended, even with items that are put in at less than a quarter of a pound per ton. Laboratory tests of random samples during a run give very close results.

It is important, especially on a continuous system, that each ingredient be put in at the proper place in the mixing line. If molasses is not properly applied or its temperature not carefully regulated, it may cause lumps in the feed. Some of the new chemicals, if added too close to others, can break down certain of their chemical properties. Small quantity items must have sufficient time in the mixing system to blend in thoroughly and uniformly. Coarse, granular ingredients, if overmixed, will separate or channel.

Many of the new vitamin and drug ingredients are available in liquid or in dry form. Oily liquids, if properly controlled, make a smoother, less dusty finished feed. At certain levels, oils will also make the feed pellet more easily and firmly, which is a distinct advantage, but the increased cost of these oils as an ingredient limits their use to a great extent.

Another consideration, when adding liquid items, is moisture limitation. Certain combinations of grains, molasses and by-products will heat and mould in hot temperatures. Careful control of ingredient and grain moistures must be maintained, especially through the summer, to keep the finished feed at a safe level.

Pelleting Feeds

At one time, cost and flexibility of the feeder system as well as appearance of the finished mix were the primary considerations for the miller. About 15 years ago, another variable was added in the form of pelleted feed. The mixed feed is sent from the mixing lines to mills where steam is added and the feed is forced through dies and then cut into pellets, cubes, etc. Recently another wrinkle was added when it was found that chickens use the feed more efficiently when the feed is neither meal nor pellet, but a combination, now known as crumbles. So not only does the miller make the feed into a pellet, but he then breaks it down on special rolls and screens it into crumbles, and the long-suffering chicken becomes an even more efficient food-producing machine.

A great deal of progress has been made in pelleting. The demand has grown from 10% of mixed feed to over 60% (in some cases even more) in pellet form and the trend is still increasing. Pellet mills have increased from an output of one ton per hour to over 10 tons per hour. Formulas must be checked carefully as certain combinations will not pellet easily or will not hold together, especially fibrous materials. The advantage of the pellet is that there is less waste in feeding and the animals get a complete formula rather than picking out what items they want from a mixed feed.

Thus, to remain competitive and at the same time make a uniform, well-mixed feed with all the recent "shot-in-the-arm" drugs, a miller must:

(1) Watch the ingredient markets, check quality of all incoming material, know each ingredient's effect on finished feed appearance and keep an adequate supply on hand without getting overstocked.

(2) Know what the appearance of each feed should be when properly mixed so he can visually approve the product of the mixing lines 20 to 25 times a day as he changes from one feed to another.

(3) Check constantly to see that the right amount of each ingredient is being used, that each is being added in the correct sequence, and establish laboratory controls on the finished products.

(4) Remain flexible enough so as to plan tomorrow's run today, and yet change today's feed formulas for the runs tomorrow as necessary without crippling production operations or upsetting his customer's pet cow.

(5) Keep equipment correctly loaded and maintained to handle from 100 to 300 tons of material per hour (or more depending on plant size) without chokeups or mixups.

Many of the larger feed companies take advantage of the sales potential of local grains, which can be purchased at a lower price than those which have to be handled through terminal markets and shipped to milling centers, by selling concentrates. These concentrates are then mixed at small local mills or elevators with their local processed grains. The advantages for the small mill are readily apparent in that it is not necessary to maintain a complex purchasing and machinery system or an extensive laboratory to check the various drugs. All that is required is to mix two, three or four ingredients and sack them off. Needless to say, the mills making the concentrates must be especially careful to maintain proper mixing and to keep the concentrated drug or protein items separated from any other complete feeds.

The states have recently devoted more attention to feed, sampling feed in dealers' stores and testing it and checking ingredient quality in the millers' warehouses. Most feed control is set up on a protein, fat and fiber guarantee basis, along with the various tests for the correct level of the new drugs which have been added. A new check which several states are experimenting with is a microscopic test to identify all the ingredients in a sample of feed to see if it matches the ingredient list on the analysis tag.

Progress Noted

As the feeds have progressed, so have the personnel, mechanical and milling techniques of the feed millers. With the increasing technical requirements of the business and highly competitive markets of the past eight years, a big change has taken place. We have seen the Association of Operative Millers set up a feed milling training course for the first time. Several colleges have established combination milling and engineering five-year courses. The millers have raised their training sights in answer to the challenge of handling the wonder drugs the chemical companies have poured at them.

New machinery has developed to improve the art of good feed mixing. High speed mixers do a better job of blending molasses. Automatic packing machines handle from 12 to 20 sacks per minute; automatic sewing machines eliminate the need for a sewing man in some cases. Bulk handling of ingredients is almost universal in the larger mills. Bulk handling of finished feeds is still in the development stage, but much progress has been made. Two or three almost completely automatic mixing systems have been installed with the latest controls and weight type feeders. Pellet mills have been revolutionized for large tonnage, long pellet die life and low maintenance. Air handling of milling streams is receiving more and more attention. The feed mill is taking on the aspect of a combination pharmaceutical laboratory and high gear assembly line.

More new ingredients are on their way to challenge both the miller in mixing and the research man in their utilization. New uses are daily being found in the feed line for by-products. Recently some gentlemen from Arizona visited me to discuss a product using cotton linters by-products as the main fiber source in a high molasses pellet. Time magazine recently carried a story about a new enzyme production of protein using water, sunshine and various waste, stating that on an area half the size of Israel today enough material could be grown to provide sufficient protein for the entire world's population. A beef steak would probably have more flavor, but the future is unlimited when you read such news.

Based on his adaptability to date, it seems a fair statement that the feed miller is enough of an artist to continue his good job of mixing the future developments the salesmen, researchers, chemists, farmers, equipment manufacturers and competitors require.

—BREAD IS THE STAFF OF LIFE—

NEW RUST-RESISTANT WHEAT TO BE GROWN

ST. PAUL—Minnesota seed growers will have about 2,500 bu. of a new Canadian wheat with promising resistance to race 15-B stem rust for use in a seed increase this year. The variety is Selkirk, hard red spring wheat known as C. T. 180 in early stages of its development.

W. M. Myers, head of the University of Minnesota agronomy department, said field tests of Selkirk during last summer's heavy rust epidemic showed it yielded better than other varieties tested. It also has satisfactory milling and baking properties.

Although now officially released by Canada, Selkirk is not yet on the Minnesota recommended list, Prof. Myers said. But it is on the "eligible for certification" list of the Minnesota Crop Improvement Assn.

Seed available in Minnesota this year includes 1,000 bu. increased by the university experiment station from five bushels obtained last year, and 1,500 bu. of registered seed which will be allotted by Canada to Minnesota seed growers.

The supply, Prof. Myers said, will be distributed to registered and certified seed growers in Minnesota's leading spring wheat counties. None will be distributed direct from the experiment station.

—BREAD IS THE STAFF OF LIFE—

4½ MILLION TRACTORS

NEWARK, DEL.—Farmers now use nearly 4½ million tractors for farm power. On the other hand, the numbers of horses and mules have gone down an average of 10% a year for the last 13 years, according to the Delaware agricultural extension service.

Rules for Safety Committeemen

Safety committeemen in industrial plants can do a great deal to help prevent accidents.

Here are the rules for a safety committeeman as listed by the National Safety Council:

1. Be alert for unsafe plant conditions and unsafe practices in your own department or elsewhere.
2. Make a practice of quickly sizing up the job performance of any worker you may watch. Notice if there are unsafe practices included which he should be warned against, and warn him.
3. Observe new employees and assist them, so far as you can, in forming safe operating habits.
4. Learn the hazards of the more general plant operations, such as: Grinding or chipping without goggles; using mushroomed tools or tools with splintered handles; oiling machinery while in motion; operating trucks too fast.
5. Be able to recognize near accidents that do not cause injuries. They are known as "near misses" and indicate unsafe practices and conditions that should be corrected without delay.
6. If you notice small cuts or bruises on workers, inquire if they have secured first aid. Caution them in a friendly way about the danger of infection.

—BREAD IS THE STAFF OF LIFE—

RESEARCH ON DEHYDRATION OF WHEAT FLOUR OUTLINED

WASHINGTON — Government-sponsored research on flash dehydration of wheat flours is described in a report listed in the Bibliography of Technical Reports, recently published by the U.S. Department of Commerce.

The research was sponsored by the research and development branch of the U.S. Quartermaster Corps. The report, titled "Flash Dehydration of Wheat Flours," is 27 pages long and includes charts and tables. It is available for 75¢ from the Office of Technical Services, U.S. Department of Commerce, Washington 25, D.C. The code number of the report is PB 111220.

The subject of the study is how to increase storage stability of prepared bakery mixes, at minimum cost, by developing a commercial process for dehydrating wheat flours without heat damage.

Dehydrated samples of less than 8% moisture content were processed under conditions of controlled air flow, temperature and flour flow feed rate. Moisture content was checked at intervals.

The design and performance of one- and two-stage flash dehydrators are described, with charts, in the report to show how they may be used to aid millers in producing low moisture flours which will yield maximum production and stability. Multi-stage flash dehydration is also considered, with indications of its future economic possibilities.

—BREAD IS THE STAFF OF LIFE—

ADDED STORAGE VOTED

MINNEOLA, KANSAS — Stockholders of the Minneola Cooperative Exchange here recently voted in favor of a 210,000-bu. expansion of the firm's grain elevator facilities in Minneola. The project will boost the firm's bin space to 580,000 bu. Present facilities can take care of 370,000 bu. Plans call for the structure to be started in April so that the bin space will be available by next harvest.

Initiation and Termination of Research Projects

By C. G. Harrel and Howard W. Lincoln
Pillsbury Mills, Inc.

PART II

Every high school student who has had general science understands that the letters E. M. F. stand for electromotive force. In a given conductor the electromotive force determines the flow of current. In this presentation, the "E. M. F.", or electromotive force of research, might be represented by:

E—equipment and environment.
M—manpower.
F—finance.

Equipment and Environment—The development of instrumentation in the last 10 years has been phenomenal. Improved instruments, processing equipment and other research tools must be available in order to compete with current competitive research. If your appraisal shows that you are limited by such equipment in any large measure, the research project should not be undertaken unless it is an exploratory field. Management should be apprised of this and either adequate equipment secured or the specific work for which proper facilities are lacking be given to laboratories that possess adequate equipment. Many of the research findings today are possible because of the advancement made in new equipment and research tools.

EDITOR'S NOTE: This is the second of two articles dealing with the initiation and termination of research projects. The first article appeared last month. The articles are a condensation of a paper presented at the Industrial Research Organization Institute at the University of Wisconsin. Mr. Harrel is director of food research for Pillsbury Mills, Inc., Minneapolis, and Mr. Lincoln is section leader of the cereal chemistry section of Pillsbury's research and products development department.

For example, storage conditions where the conduct of keeping quality tests on food products at different temperatures and humidities must be available. Constant and cycling storage conditions are a requirement of the efficient food research laboratory.

The necessity for adequate equipment is but one phase of providing a desirable environment for a smoothly operating research laboratory. Several other points to consider in this regard are as follows:

1. Investigators must be at all times in a receptive mood. This is most readily established by proper physical and mental environment.

2. The environment must be such that each man feels he is contributing directly to the project. It is not sufficient that the research director know that the individual is contributing, but the research worker himself should know and feel that some of the top officials are aware and appreciative of his contribution. This is facilitated by affording top officials opportunity to review some of the outstanding achievements and meet the personnel responsible.

3. Research workers should be spared the inconvenience and time consumed in securing materials and equipment. This can be done far more economically by the establishment of a service department.

Manpower — Of increasing importance is the "M" of the "E. M. F." of research. At present the demand for manpower is greater than it has been at any prior peacetime interval. Eighty-three per cent of the members of our team report that their projects are limited by the lack of manpower.

The present shortage of technically trained personnel is due to several factors:

1. The demand for men and women with scientific training is steadily increasing. An outstanding illustration of this was reported in the fifth annual conference on the Administration of Research at the University of Michigan in 1951. Whereas the Bendix Aviation Corp. had at one time required one engineer for every 55 workers, in 1951 it required one en-

Questions & Answers ON PY-RAN

Q A What is PY-RAN?

PY-RAN is the new, coated, anhydrous monocalcium phosphate leavening agent just put on the market by Monsanto.

Q A Just what is meant by "coated?"

Each granule of PY-RAN has a moisture-absorbent covering which protects it against premature reaction during storage or shelf life.

Q A What can PY-RAN do for me?

Give you leavening *stability* never before possible.

Q A How will this stability affect the shelf life of my products?

Aging tests conclusively prove PY-RAN's superior stability increases the life of prepared mixes and self-rising flour. The special coating retards premature reaction. Deteriorated, returned goods are reduced to a minimum.

Q A How will this greater stability affect the release of CO_2?

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Q A What other advantages has PY-RAN?

Slow, controlled release of gas as produced by PY-RAN gives excellent texture, volume and crust and crumb color. Tunneling is virtually eliminated.

Q A Can PY-RAN be used in conjunction with other phosphate leavening agents?

Yes. PY-RAN will blend perfectly with other leavening phosphates such as Monsanto SAPP and HT phosphates.

Q A How can I find out more about PY-RAN?

We will be glad to furnish you samples so you can see for yourself what it will do. In addition, our completely equipped food laboratory is ready to work with you to show you the best way to use PY-RAN and other of the Monsanto leavening phosphates for maximum results. For more information or a copy of the new booklet, "MONSANTO PHOSPHATE LEAVENING AGENTS," write to MONSANTO CHEMICAL COMPANY, Inorganic Chemicals Division, 1700 South Second Street, St. Louis 4, Missouri.

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gineer for every 11 workers, a 400% increase. While this example may not be typical, it indicates how demand has increased in some industries.

2. While demand has skyrocketed, the supply of people with technical training has not kept pace. In fact, the total number of persons receiving degrees in chemistry, including bachelor's, master's and doctor's, has decreased from 13,400 in 1939 to a predicted low of 6,700 in 1953. What has caused this alarming condition?

In the first place, the low birth rates of the 30's are having their effect on the number of students graduating from colleges. In addition, for a number of years following the war, various reports and some trade talk forecast excessive supplies of technical talent, poor pay, limited opportunities and small social recognition in scientific fields. These reports discouraged youngsters beginning technical careers. Finally, the resumption of compulsory military service in 1946, in effect, caused a two- to four-year drouth in technical graduates.

3. There is no substitute for competent manpower. When backed by experience it becomes the greatest asset any research laboratory can possess. This essential manpower must be available or the chances of successfully completing a chosen project will fall far below the 20-38% successful research projects reported previously.

The rapid advancement and specialization in the sciences have produced men specifically equipped for the pursuit of specialized investigation.

4. Manpower is expensive, and the cost of securing personnel for any project must be thoroughly investigated. Ruark has summed up the cost of manpower as follows:

"Management expects economic research. Research facilities are costly and require continual replacement and continuing capital investment. Research manpower is short in supply and expensive to procure; modern hiring methods for technical personnel require the expenditure of hundreds of dollars or thousands of dollars per person hired and this cost increases year by year.

"Once a laboratory is established, the most important continuing expenditure is manpower since it is not infrequent for salaries and wages to constitute 80% of the research budget exclusive of overhead. It is difficult to get the research worker to understand this, and frequently his efforts to save money by spending time result in an over-all loss.

"Proper utilization of manpower is the most important single factor to be considered in providing economic research. Technical personnel working inefficiently constitute a more than complete loss, since not only is their time non-productive but the funds that paid for it could have been used in other ways to guarantee certain productivity."

Realizing the high cost of manpower, a company would be wise to develop an over-all manpower improvement program after those men have been acquired. Any organization that goes to the initial expense of securing personnel and then permitting them to become static does not provide the individual with an opportunity for improvement, and the organization will not realize the most from its manpower.

Finance—Ruark has this to say in regard to cost considerations in research:

"The question of quality versus economy frequently occurs early in research project discussions. In my opinion, initial research should be directed toward quality alone. In the early stages, the research man should not be plagued with problems of economics, but should be allowed to produce the finest material possible without regard to cost. Once the product has been created, the fight towards cost reduction, without quality sacrifice, can begin. It has been often emphasized that raw material cost has little effect on the economics of bringing a product to market during the early years of its production. This is particularly true in days of high capital investment requirements, and high rates of taxation in the presence of relatively low rates of depreciation."

This opinion, in our estimation, is at least 95% true. An individual may economize on building materials—even on clothing and other necessities of life—but the demand is for foods of top quality to supply convenience and to satisfy taste desires. These two points are even considered more important than the nutritional quality of foods by the average consumer.

Factors to Consider

The following factors should be considered with regard to finance:

1. The calculation of the chances of success of a project is in a sense the reciprocal of the calculated risk. There are those investigators who have outstanding records of achievement who say any attempt to arrive at a calculated risk or a chance of success is no better than a wild guess. Others feel there are specific methods evolving which may serve as tools to executives aiding them to make decisions more correctly.

One method is called "Operations Research." A committee called the Committee on Operations Research, National Research Council, Washington, D.C., has been formed to develop this technique. Suffice it here to say that this method substitutes mathematical probability for the less objective common sense and intuition of the executive. In fact, a mathematical model of the proposed operation is constructed consisting of complex mathematical relationships. By varying the components in the model, the researcher can vary the overall effects and the varying results of a decision can be obtained for explicit examination. It is to be hoped that

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this committee develops a most effective method, but let us not forget what past history reveals—that the judgment and intuition of many leaders in industry have been highly successful.

E. Duer Reeves, executive vice president of Standard Oil, in his presentation at the fourth annual conference of Administration of Research at the University of Michigan, suggests that equivalent costs of research may be obtained by dividing the estimated costs of research by the chances of success. Thus he obtains a comparative figure to apply for evaluation of all research projects, known as equivalent cost.

Reeves gives us a further calculation and arrives at a desirability factor, which is the estimated financial return to the company divided by the equivalent cost. This latter figure he uses as an index for selecting projects. A desirability factor greater than one indicates possible initiation. A factor less than one suggests immediate rejection.

Other methods could be proposed. Ninety-seven per cent of the returns from our team stated that they had no adequate method for arriving at the estimated chances of success. Indeed, this is probably the most difficult factor to be determined in the subject of finance.

2. Research costs can be estimated both in fundamental and applied research. In arriving at this estimate there is a wealth of material available on the cost of manpower, overhead, etc. The Industrial Research Institute has collected much data on this subject. Research costs should be estimated as accurately as possible with a reasonable margin for rising prices, both in materials and salaries. It is to be emphasized that this small reserve must be reasonable and an undue amount of safety factors or padding inserted frequently does more harm than a closely figured estimate. It frequently results in discouragements in undertaking projects.

Capital Investment

3. Capital investment includes the capital required for building of new plants, consumer surveys, introductory advertising and sales expense. The manufacturing, sales and advertising departments should be called on for their interpretation as to what previous products on which case histories have been established which the new product or process most closely resembles. Thus by amology some estimate as to the total capital investment required may be reached.

4. An estimated return to the company over the first five years is another figure that must be calculated. One or even two years is not sufficient, especially in food products. In the first year and part of the second year stocks are built up. This period is the one in which the consumer is trying out a new product, possibly to satisfy her curiosity. History is full of cases where a company has had premature enthusiasm and later found out that they were simply shelf-stocking and the repeat demand did not materialize. In other words, the market selling of the new product must be determined over a sufficiently long period of time. These calculations require very close cooperation with sales, production, cost accounting and commercial research departments.

The acceptance of the product in years should be estimated. It is frequently found that many products retain consumer appeal over a period of 10 or 20 years. This is particularly true of food products as human tastes are not subject to quick change once a particular taste pattern for certain types of foods has been established. For example, the Cubans who at all times have a surplus of sugar in their country do not desire bread that contains sugar. Down through the ages their tastes have been accustomed to non-sweetened bread, and all attempts to include sugar have met with failures. These projects of long life periods are sometimes sound even when they do not yield as high a yearly income as products of short-life duration.

The estimation of the continued acceptance of a product takes into consideration the possibilities of new products being developed. These may replace the existing products from an economic standpoint of production or consumer demand. Prepared mixes are gaining in popularity because they possess an economy to the consumer that cannot be equalled by assembling the individual ingredients in the home. In addition, they possess the advantage of convenience.

Compiling Research Data

Many systems exist for the compilation of research data. One such system consists of a form which is a summary of a research and development project proposal. It summarizes more detailed data presented in supplemental forms which give a place to record standard calculated data. These supplemental forms are for convenience in making comparisons and should not be presented for executive decision.

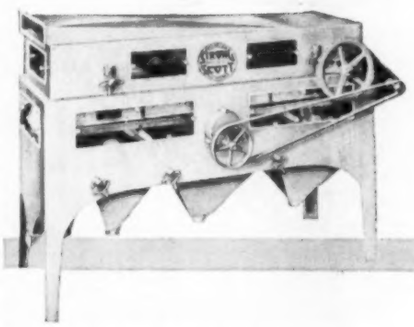
Let us consider the form as giving a summary for a Product X, representing an improvement in an existing product. It is proposed that Product X be developed so that the time of preparation can be reduced approximately 77%.

Because the proposal is an improvement in an existing product, all of the present equipment used in its manufacture can be utilized. This lowers to some extent the capital investment for equipment.

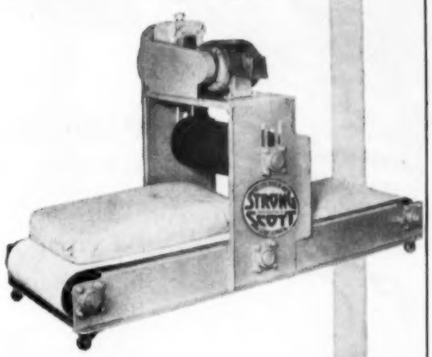
Research costs for this proposed

CUT OPERATING COSTS

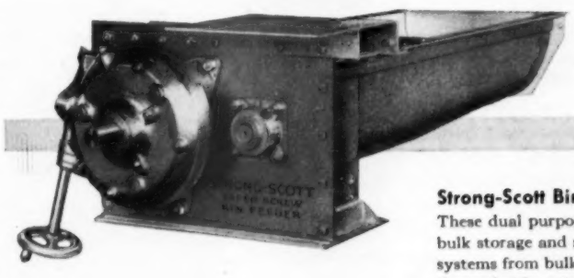
WITH... these Strong-Scott machines designed especially to increase the output and efficiency of your flour mill.



Strong-Scott Aluminum Purifiers
A unique arrangement of multiple underside hoppers and valves gives Strong-Scott Purifiers a minimum upkeep and maximum capacity advantage over other makes. Available in 3 sizes with or without fan and with either roll or shaker feed.



Strong-Scott Bag Flatteners
Designed to flatten filled, 50 to 100 lb., multi-wall or cloth bags at a rate of 300 to 500 per hour. Available in standard and jumbo sizes.



Strong-Scott Bin Feeders
These dual purpose units blend flour from bulk storage and mix feeds on continuous systems from bulk bins. Stock is conveyed to the packer in a steady, uniform flow within a capacity range of 5 to 500 bushels per hour.

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Minneapolis 13, Minnesota

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"Everything for Every Grain Elevator, Feed Plant and Cereal Mill"

project are estimated at $83,000. Our capital investment is estimated at $93,000, making a total capital requirement of $176,000. The estimated return to the company over a five-year period is $2 million, or $400,000 annually. Therefore, we have a yearly return of $2.27 on every dollar of capital invested.

The proposal also shows that the estimated life of the product is 20 years, that the expected date of completion of the project is five years from the date of starting, that patent protection can probably be secured, and that four to six months of intensive exploratory work should be conducted before any definite decision on the project is made.

Chances of success (research and commercial feasibility) are estimated at 50%. Reeves' figure for equivalent cost of research would be $352,000. His desirability factor or ratio is 5.7.

This project was selected for initiation because the estimated return is high and the capital investment is low in relation to the expected return.

Another Proposed Project

Consideration will now be given to another proposed project. This, we will assume, is to determine whether an export product can be made on idle equipment. The chance of success (research and commercial feasibility) is estimated at 75%. The expected total investment is $3,400, for research costs. The estimated life of the product is five years. The estimated return over the first five years is $2,700 (15.9% annually). The expected date of completion is 10 days after initiation. Patent protection can probably not be obtained.

In this case, the research costs are low, primarily because there has been some accumulated knowledge available. A market survey, however, shows that the cost of the research required to determine whether or not certain processes and equipment possessed by the company can be utilized will not be paid off in a period of five years. Therefore, this project is rejected on the following grounds: (1) The financial return is low; (2) the product's market life is short; (3) no patent protection is obtainable; (4) export markets are exceedingly unstable at this time; (5) the equivalent cost of research is $4,720; (6) the desirability factor is 0.57, which is entirely too low in comparison with other proposed projects.

Record of Termination

The answers our team gave to the question, "Does your company keep a record of projects that fail and make a systematic study of them as to why they fail?" were surprising.

It was found that only 29% kept such a record; 64.5% stated they did not compile this information and the remainder of the replies were indefinite.

An immediate record at the time of termination is exceedingly valuable as an evaluation six months or a year later is often complicated by vagueness and uncertainty.

We feel that such a record should contain the following: (1) Date of termination; (2) reasons for termination if unsuccessful; (3) manhours expended, and equipment, materials, supplies and services purchased; (4) cost; (5) why it failed.

This record of termination provides:

1. A valuable guide for study of new proposed projects of similar nature prior to initiation.
2. A record of research activities to aid management in evaluating research performance.

* * *

A noted educator once said: "If you are not creative and capable of producing new concepts and ideas, you are mentally dead and do not deserve to live in this day and age." This gentleman made this statement in regard to individuals, but it can readily be applied to your research organization.

* * *

SUMMARY

1. The complexities of modern research force the research administrator to rely on a team composed of members from within and without the research department.

2. The world's ever-increasing population makes the production of increasing volumes of food imperative; thus a type of research is essential in the food industry which we call mandatory.

3. With higher costs, more research competition and higher taxes, the careful selection of projects to maximize the research group's chances of success is more important than ever before.

4. The research directors consulted felt that the most outstanding research trends in recent years involve increased study prior to selection, more widespread use of other groups within the organization, and the increased use of objective selection techniques such as "Operations Research."

5. The process of project termination involves essentially the same processes as project selection, and for the same reasons is vitally important to a research department's success.

6. While the individual replies varied greatly, the average reply from the research directors consulted indicated that approximately two out of every five projects initiated were successful.

7. It was interesting to note that of the reasons given for project

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HIGHEST QUALITY

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failure, many could be attributed to improper initiation.

8. In attacking the problem of initiation and termination, three principal areas need to be considered:

(a) Adequate physical facilities of the laboratory and an environment conducive to free and creative thinking.

(b) Sufficient trained personnel to conduct the investigations.

(c) The financial return expected to result from the project.

9. It has been found very helpful to formalize the selection process through the use of selection and termination forms, but it must be emphasized that these forms are merely a system to record the final judgment of the team, namely the research department and other departments of the company.

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Reeves, E. Duer—"Calculated Risk—Its Place in the Selection, Control and Termination of Research Projects—II," an address delivered before the Fourth Annual Conference on Administration of Research, University of Michigan, September, 1950.

Feed Production Techniques Covered at Midwest School

Almost every phase of formula feed production was covered at the Midwest Feed Production School in Kansas City. The three-day school attracted 300 feed men from 29 states. Following are summaries of some of the talks given at the school:

• • •

PRODUCTION PLANNING

Until everything in production is planned ahead, feed mills are wasting money, said C. A. Tolin, regional production manager, Ralston Purina Co., St. Louis. He said most feed plants are getting no more than 30 minutes of work out of every 60 paid for. Most production headaches, he said, result from not planning ahead—not planning such things as having sufficient raw materials or space for manufactured tonnage.

Before scheduling can be effective, certain basic knowledge is necessary. Mr. Tolin advised: Make a flow chart of equipment to show its capacity and also show storage space; then eliminate bottlenecks. Analyze jobs and write up complete job descriptions and post them. Analyze storage space and have space assigned for reasonable supplies. Have adequate intermediate storage between operations, such as bin space ahead of

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One man loads the Hytrol. No heavy lifting, just tip the bag against the belt. Another man at the top places the bags. According to a Wyoming user, these two men with a Hytrol stack more bags than four to six men did manually.

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The Simon Purifier has all-aluminum construction . . . provides great improvements in air control and distribution . . . design eliminates ledges where stock accumulations might permit insects to breed.

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Aluminum spouts are easily removable for cleaning . . . mechanical complications are avoided by design of new feed gates.

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Easily adapted to various flow diagrams . . . to large or small mills . . . for hard or soft milling . . . facilitates production of special grades. May we supply you with specifications?

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pellet machines. Analyze maintenance and inspection needs and use this as a basis for maintenance and regular check-ups and responsibility. Make an organization chart showing every man, flow of responsibility and size of crews.

Mr. Tolin recommended estimating monthly tonnage, planning ahead and determining ingredient needs. Then a week's output should be planned. He stressed that runs should be as large as possible and changes should be held to a minimum. To do this, it is necessary to plan floor stocks and know what is required and when.

Keeping Men Productive

Keeping men productive requires planning of such factors as machine operating time, number of men required, timely ordering of supplies, and efficient use of space.

Managers should see that each foreman knows his share of the daily tonnage goal. Then each foreman should let his men know their share. The previous day's goal and accomplishment should be posted. If more than one shift is run, tons per hour should be compared, stimulating a competitive spirit. Any manpower shifts should be planned ahead and the men taken to another assignment. Operations should be flexible and the use of men planned.

Mr. Tolin suggested a daily "council of war" of the plant management group. Yesterday's problems should be reviewed; correct as many problems as possible immediately and plan to overcome the others.

Mr. Tolin urged that foremen be brought in on planning since they are the key to success in scheduling. He also stressed the importance of informing workers, making them interested. And he pointed out how incentive plans can be made to work.

Information brought out at a question and answer session included this: Raw material shrinkage in a feed plant—as low as ¾%; 1% is a good figure. Man-hours for cleaning and housekeeping in a 100-ton-a-day plant —.15 man-hour is not out of line. Problem of making small quantities of feed—require advance notice from the sales department. Maintenance men in a 100-ton-a-day plant—three if there is a good size boiler operation.

Incentive plan—the plan should be based on time studies and tailored to a plant; there should be an allowance of 20% for personal needs; it's possible to get 45 productive minutes out of an hour instead of 30 minutes; incentive plans can be used in union plants as well as other plants if worked out ahead of time.

Production costs—it's possible to approximate or estimate total cost per ton of feed. In the Midwest, with a good planning job, the figure might be $6.50 per ton, including labor, depreciation, insurance and other factors. The figure might be as low as $5 or as high as $12.

* * *

PELLETING

Noting the increase in pelleting in recent years, Lowell Judd said that a recent survey by the American Feed Manufacturers Assn. indicated that 75% of all feeds produced were pelleted. Mr. Judd, superintendent, Albers Milling Co., Kansas City, added that more conservative estimates indicate this figure is closer to 65%, but in the Kansas City area the 75% figure would hold true.

Generally, he said, it is customary to charge about $2 per ton on pelleted feeds over mash. When costs of operating and equipment are considered, this is not a very great margin, indicating efficient operations are necessary. Mr. Judd said many factors are involved in computing operating costs, and a considerable variation has been found. Variations depend on such things as location and condition of plant, type of equipment and type of product.

He listed cost ranges for various items in pellet mill operations as follows, per ton: labor for pelleting (direct and indirect), 25 to 75¢; power, 10 to 50¢; steam, 10 to 35¢; dies, 8 to 50¢; rolls, 3 to 30¢; repairs and maintenance, 3 to 15¢; interest and depreciation on equipment, 15 to 75¢; building occupancy, 7 to 20¢; general and administrative, 5 to 20¢. Total cost per ton—86¢ to $3.70; average—$2.28.

Mr. Judd outlined several points in achieving best production: (1) Correct steam application—a hot, dry steam should be used. (2) Proper roll setting—most effectively determined on a trial and error basis; it is advantageous to install new rolls and die simultaneously. (3) Oiling — use grease which will not break down under high temperatures; grease rolls every eight hours of operation. (4) Proper personnel — operators should be of high caliber with maximum initiative and some mechanical ability; one man should not operate more than four high-speed mills.

(5) Molasses—when molasses content is high, Mr. Judd said, it is necessary to add at least part of the molasses ahead of the pellet machine. One method of adding molasses is to put it in with the steam. Generally in the production of high-molasses cubes the amount of steam decreases as the amount of molasses increases; an even flow of molasses to the mill is necessary; the best method is the use of a positive displacement pump.

(6) Conveying pellets—When possible, pellets should be cooled before elevating. With hot pellets, stainless steel buckets, bolts and legs are helpful; rubberized belting helps; air conveying is being used; and plastic buckets are now being used.

Points raised in the question and answer session included these: Greasing pellet mill rolls—some recommend greasing every four to six hours. Steam—30-lb. steam pressure seems about right; it also was said that the quantity of steam is what is important, and pressure depends on what the equipment is designed for. Percentage of pellets reduced to fines in making crumbles—25% about average; as low as 10% fines result on a two-break system. Roll size and speed in crumblizing—9 in. roll best for cutting effect; speed differential, as much as 2 to 1 may be needed. Life of die — 2,500-3,000 tons was mentioned as good normal die life, but it was noted that die life depends on certain factors, including materials, and it was suggested that

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operators watch the mills and pellets and check the time. If too much fat is used in pelleted feeds, friction is reduced and pellets go through too fast. Sodium bentonite is used to produce harder pellets.

* * *

GRINDING

L. D. Ketchum, manager, Staley Milling Co., East St. Louis, Ill., outlined different types of grinders and methods of grinding. In controlling quality on a hammer mill, it is first necessary to decide on the grind. This will vary with several things—load on the mill, space between tips and screen, screen opening, speed of mill. In a given hammer mill, some of these factors are constant, but Mr. Ketchum cited tests on the variation of grind with a varying load. In one mill grinding the same grain, there was a considerable variation.

Mr. Ketchum also pointed out that most efficient use of electricity is obtained when there is a full load. The current on the very light load in the test was about 69% of the full load current, while the amount of material was far below that. In keeping a full load on the mill, Mr. Ketchum said, plenty of fan capacity is needed. There are instruments available for automatically keeping a full load. Also handy is an elapsed time indicator which will show the number of hours the motor has run.

Factors affecting capacity of a mill are type of material being ground, moisture, weight, and condition of hammers and screen size.

Points raised at the question and answer session included: Size screen on hammer mill to pulverize corn or milo when making crumbles—average, ¼". Grinding equipment for badly caked urea—any type hammer mill; problems may be avoided by mixing urea with gluten feed or cottonseed meal.

* * *

HANDLING INGREDIENTS

Both bulk and sacked ingredient handling have a part to play in a feed plant, said R. S. Sheehy of the production department of the Quaker Oats Co., Chicago. In considering a bulk system, he said, a thorough study should be made. Perhaps the most important consideration is the relationship between plant location and location of ingredient suppliers. Aside from the over-all size of a feed operation, the key to a successful bulk system is in careful scheduling of arrival of ingredients. Without such scheduling facilities for bulk may be necessarily expanded all out of proportion to size of the business.

On a fair percentage of ingredients, he said, it is impossible to use bulk. Or, if a bulk system is not contemplated, and an entire operation is planned for sacked ingredients, there is room for improvement along these lines. Mr. Sheehy said he would consider a palletized system as the most flexible and efficient arrangement in terms of units per man hour handled. Here again, he added, a study should be made.

Discussing bin design to insure proper flow of ingredients, Mr. Sheehy said his company had used a number of bins of varying size and shape with fair success. The most trouble, he said, has come on hoppers. "Generally," he said, "we have used 60° conical hoppers on round bins and 70° sloped hoppers on square or rectangular shaped bins. Wherever possible, it is advisable to use one or two straight sides on a hopper."

He said they had handled the following ingredients in bulk: brewers grains, linseed meal, cottonseed meal, screenings, meat scraps, clovogras, shorts, hominy feed, alfalfa, soybean meal, gluten feed, bran, oat feed.

* * *

DUST CONTROL

Dust control involves two problems —collection at the source and separation and collection from the air stream, explained Arden E. Swanson, manager, filter sales, The Day Co., Minneapolis. In removing dust, he said, the hood should be put as close to the source as possible, and it should be located so that the operator is not between the source and the hood opening. Piping should be smooth and have a minimum number of elbows.

Mr. Swanson said centrifugal separators, more commonly termed cyclone collectors, are the most widely used type of dust collection equipment and vary in size and shape. Collection efficiencies vary from 55 to 99% and are much dependent on the particle size, he said. Normally, he added, dusts less than 20 microns in size show low collection efficiencies, whereas particles in the 40-80 micron range have shown efficiencies as high as 99%.

Mr. Swanson said the most efficient type of collection device is the cloth or fabric filter. This group is divided into two classes — the mechanical (shaker) type and the Hersey type. In the shaker type the dust-laden air is passed through a woven fabric which filters out the dust. Actually the pores in the cloth are much larger than the dust particles, and the collection efficiency is low until a dust layer has built up on the inner surface. However, in order to clean the fabric the dust layer must be disturbed as the shaking devise is turned on. Collection efficiencies on particles less than 1 micron as high as 99% are attained, Mr. Swanson said. He said one disadvantage is low capacity

(Continued on page 18a)

—to promote better health

TO promote better health, mere enactment of laws is insufficient. Experience has shown that effective education of the public in nutritional matters depends to a great extent on the dissemination of the principles of nutrition, food values and related subjects. If the public is properly educated, it will naturally prefer the *improved* staple foods over those which are lacking in good nutritional value.

THE practice of enriching or fortifying foods for better health is becoming more widespread. For example, enrichment of many cereal foods, the fortification of certain fruit and vegetable juices, and of margarine, are accomplished facts in the United States. The list lengthens because food processors know that, fundamentally, the most important factor in foods is nutritive value. So they are making their good foods better—to the benefit of millions of people.

THE firm of Hoffmann-La Roche has for many years pioneered in the production of vitamins for the food and other industries throughout the world. These vitamins, synthesized by chemists, are identical with those existing naturally and are manufactured on a large scale at a much lower cost than if they were extracted from natural sources. These are the vitamins that are used for flour and bread enrichment, the process which to a great extent restores important nutritional values which are unavoidably lost in the milling and processing of wheat when fine, white flour is produced. Rice, corn and other cereal grains are similarly restored and fortified.

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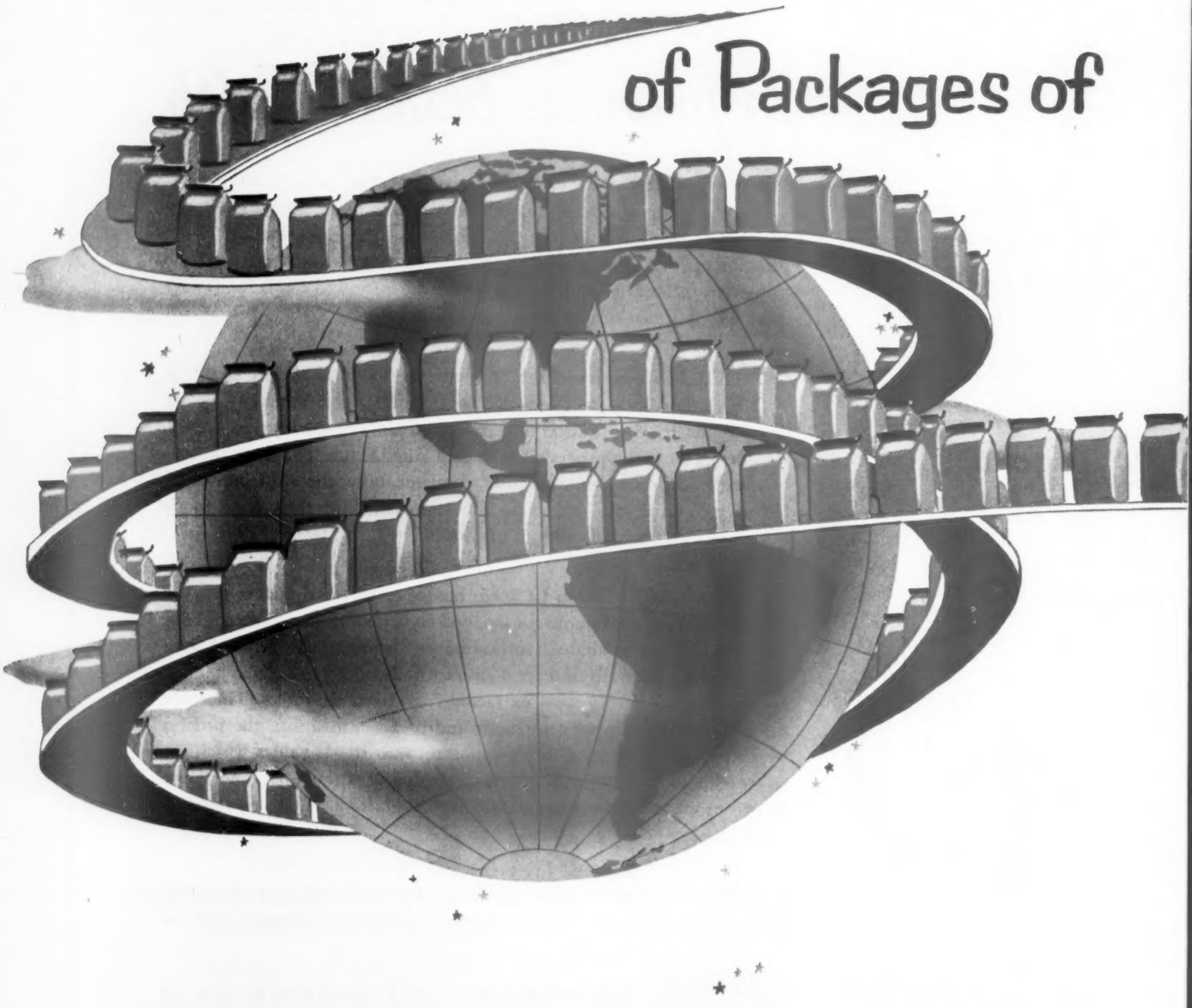

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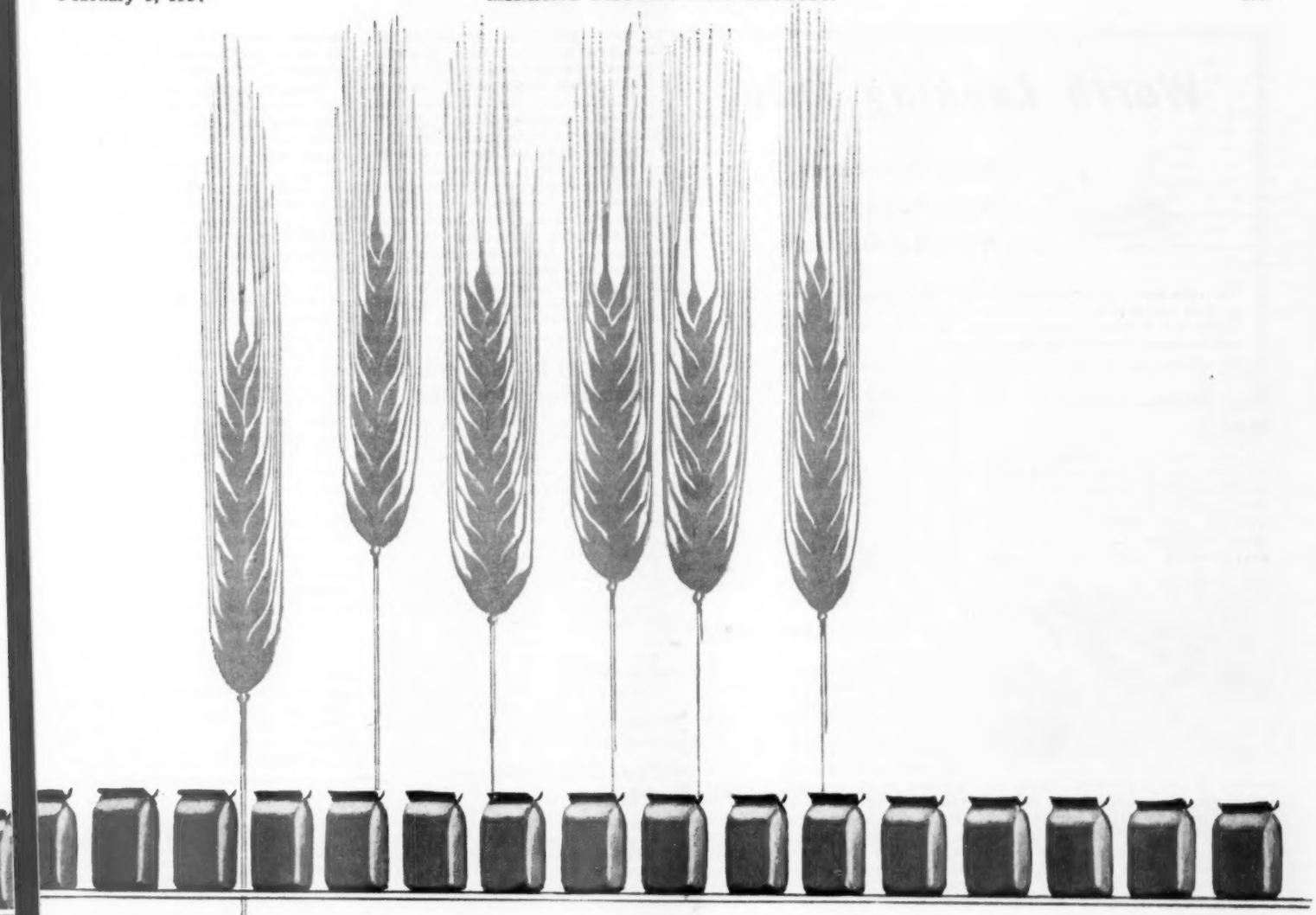

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V-90's 15 years of shelf-life experience is extremely important to millers because quick tests are dependable only when based on and confirmed by actual field performance. The only reliable test is years of experience in the field under all conditions of heat and humidity. When your self-rising flour has passed this test, *you're sure!* The element of risk is eliminated.

For over 15 years, V-90 has been producing outstanding results in all kinds of pre-leavened products. To quote a major user . . . "The introduction of V-90 was the beginning of the end of the miller's troubles with self-rising flour." This is because V-90 excels not only in shelf-life but *also* in the *slower* release of leavening gas during the critical two-minute mixing period.

V-90 remains the *only* anhydrous monocalcium phosphate that the milling industry can use and *know* that baking results will always be best.

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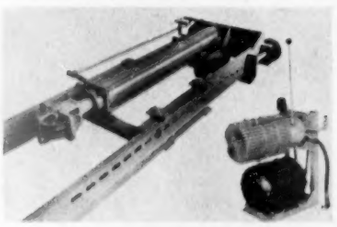
No. 2790—Truck Hoist

A new hydraulic truck hoist, called the Hydralift, has been developed by the Strong-Scott Manufacturing Co. It is said to be the first overhead hydraulic truck hoist ever manufactured. "One lever" operating mechanism gives the operator positive, easy



control. It has a powered stroke up and down. The speed of lift can be varied up to 20 ft. a minute. Hydraulic action prevents accidental dropping, it is claimed. Head room requirements are 11 ft. from support timbers to the roof. The motor, pump and controls can be placed with present electrical facilities or can be mounted overhead out of the way with remote controls. The hoist comes in three sizes: 3 h.p. 5,000 lb. lift, 5 h.p. 7,500 lb. lift and 7½ h.p. 10,000 lb. lift. In addition the overhead frame is available in three standard sizes: 10 to 12 ft. adjustable, 12 to 14 ft. adjustable, and 14 to 16 ft. adjustable. Further details may be secured by checking No. 2790 on the coupon and mailing it.

No. 2801—Weighing System

Richardson Scale Co. has announced a new automatic tare-weighing system for foods and chemicals, either liquid or solid form. In this system, a drum, can, cylinder or box is automatically tared and then filled with product until a selected weight is reached. The precise weight of product in the container is then recorded or printed for permanent record. Containers may be fed to the weighing platform manually or by an automatic indexing system. Automatic controls govern all phases of the weighing process. Taring is accomplished instantaneously by instruments fitted to the scale. The automatic scale used in this system is said to have an accuracy of less than 0.1%. The product is weighed in the shipping container and not in a weigh hopper. In effect, the container here serves as a weigh hopper. Over-under control may be applied, if required. With this control, the process would automatically shut down when an overage or underage occurred, the company explains. A permanent record of the weighings may be given to the customer. Get more information by checking No. 2801 on the coupon and dropping it in the mail.

No. 3474—Materials Handling Booklet

The proper relationship between material handling and other functions in an industrial organization such as process engineering, industrial engineering, plant layout, production and material control, purchasing, production, quality control and inspection, accounting, maintenance, personnel and product design is explained in a new 12-page booklet published by the industry educational committee of the Material Handling Institute, Inc. General rules for analyzing work-volume and work-density are also presented with an example in chart form of work-volume analysis. Copies of the booklet may be obtained (50¢ each) from the Material Handling Institute, Inc., 813 Clark Bldg., Pittsburgh 22, Pa.

No. 2788—Diesel Plants

A catalog of Cummins Diesel power plants is announced by Cummins Diesel Sales Corp., along with a magazine for power users, entitled "The Dependable Diesel." The catalog gives specifications of the company's Diesel plants for many types of power, both stationary and portable. The magazine explains the various uses to which Diesels are being put, including the powering of grist mills. Both the catalog and the magazine are available without charge by checking No. 2788 and mailing the coupon.

No. 2800—Doors

The "Electric Doorman" is a new eight page bulletin-catalog issued by the Electric Power Door Co., Inc. Illustrated with representative installations of warehouse doors, electric eye special problem doors and controls, it includes complete specifications, applications and information on folding, swinging, sliding, overhead and craneway doors. Blueprints, erection diagrams, selection tables and construction features are shown along with necessary hardware and recommended control systems. It also describes the company's engineering service available to industrial and commercial users of doors and gates. Catalog No. 1000 may be obtained by checking No. 2800 on the coupon and dropping it in the mail.

Send me information on the items marked:

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Feed Production

(Continued from page 15a)

in respect to air volume per square foot of cloth.

In the Hersey filter, the dust-laden air enters a vertical tube at the top and flows downward and out through the filter media, the dust being trapped on the inner surface. To dislodge the dust collected, the principle of reversed air flow is used. Mr. Swanson said wool felt is used in this filter as it is an excellent filter independent virtually of the dust layer.

"Because the filter does not depend on a pre-coat of dust for its high collection efficiency and because constant porosity is maintained, much higher filtering rates are attained at the same pressure drop," Mr. Swanson said. "Higher filter rates mean less filtering area and consequently less space requirement." This type is 99.9% efficient on dust less than 1 micron, he said.

* * *

FUTURE DEVELOPMENTS

Discussing future developments in feed processing, Dr. Max Thornton of the Midwest Research Institute, Kansas City, urged studying of processing problems on a more extensive scale than at present. In recent years many new engineering techniques have become available, he said, and more use is being made of the fundamental approach to problems in engineering.

"There has been a great deal of development work carried out on various milling operations such as are necessary in the feed industry," he said. "However, there are many indications that a more fundamental study of this process would pay dividends in improved efficiency."

Dr. Thornton said that among the operations where there are possibilities of improvement is preserving of feed ingredients—including dehydration and drying. In preparation of feed for the consumer — including grinding, mixing, etc.—there also will be attempts to bring greater efficien-

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cy, he said. Dr. Thornton also said that greater complexities of feed formulas may result in further developments in process to hold ingredients together.

(Also see story in December issue.)

* * *

INSECT CONTROL

George Wagner, director of the economic biology department of Pillsbury Mills, Inc., Minneapolis, explained types of insects — including the true weevil and bran bug types— and he outlined control problems and procedures. He pointed out that insect infestation in feed mills can and does affect profits and customer acceptance.

To help control insects, there should be regular inspections of raw materials and storage space, plant building and machinery, finished feed warehouse, and the loading and unloading areas adjacent to the plant. If insects are found, fumigation should be used as soon as possible. Good cleaning is necessary because accumulations of material in any place in the mill, particularly in summer months, support insects.

Mr. Wagner pointed out that pressure and heat in the pelleting process kill insect life, but if infested mash is stored adjacent to pellets, the pellets will become infested.

Steps in insect control with feeds include: Keep floors and walls clean; store stocks on pallets; have adequate space between tiers for inspection and cleaning; practice inventory control, with the old out first; use residual insect toxicants where necessary. Rodent control and bird control also are important.

* * *

PAPER BAG HANDLING

The best conditions for paper bag storage and packing are at 70° F. with a relative humidity of 50 to 60%, said R. J. Stevens, sales manager, paper bag division, Chase Bag Co., Chicago. Under these conditions bags are flexible and strong. Hot dry air will reduce the moisture content of bags, so they should not be stored in such locations. Also, empty sacks should not be stored in below-freezing temperatures.

The most desirable way to control moisture content of the bags is to have a humidified storage room. Various types of humidification control systems are available. If it is impractical to completely humidify the storage area, Mr. Stevens said, the mill can have a small humidified room between the main storage and packing floor which is large enough to hold bags for 24 to 48 hours of production.

If two-wheel hand trucks are used in handling sacked feeds, they should have guards placed over the wheels to prevent abrasion. Some persons have successfully used "miniature pallets" with small stacks of bags to be moved around the plant on hand trucks. The pallet is simply a board with channels at each end to allow the lip of the hand truck to get under the load stacked on the pallet.

* * *

FEED MILL OF THE FUTURE

In considering the feed mill of the future, H. O. Heckmann first described a modern mill of today. Mr. Heckman, engineer with Jones-Hettelsater Construction Co., Kansas City, outlined factors and equipment going into the design of the modern mill.

These included: to provide efficient handling of ingredients and finished feeds — adequate tracks and truck facilities, track scale, air handling system and belt system; to protect expensive equipment and avoid shutdowns — magnetic protection on incoming streams and ahead of grinding equipment; to produce quality feed—cleaners for grain and scalpers for soft stock; to efficiently handle carload lots of soft material—larger than carload bins in the mill building and additional soft stock bins; with the increased use of liquid products—adequate provisions for handling and proportioning liquids; to recover efficiently expensive stocks—cloth type collectors; a batch system for greater flexibility; pre-mix facilities for the trace items going into today's feeds; air operated slides above and below the batch scale, as well as on mixer discharges, to provide fast, accurate weighing; to provide sufficient mixing time—a double mixer layout so that one is available while the other is off.

Mr. Heckmann also listed these points: to assure practically continuous, smooth operation beyond the mixers—a surge hopper and screw conveyor under the mixers; bulk loading facilities to meet current demand; adequate pelleting and crumblizing facilities to meet today's demand; with increased use of molasses—better means of handling it and the feed after it is added; more efficient cooling of pellets; adequate belt conveyor system to keep pace with high speed packaging; adequate dust collecting facilities to salvage valuable stocks and provide cleaner plant; good locker and other facilities for good employee relations; to obtain best insurance rates—fireproof construction and proper electrical installations.

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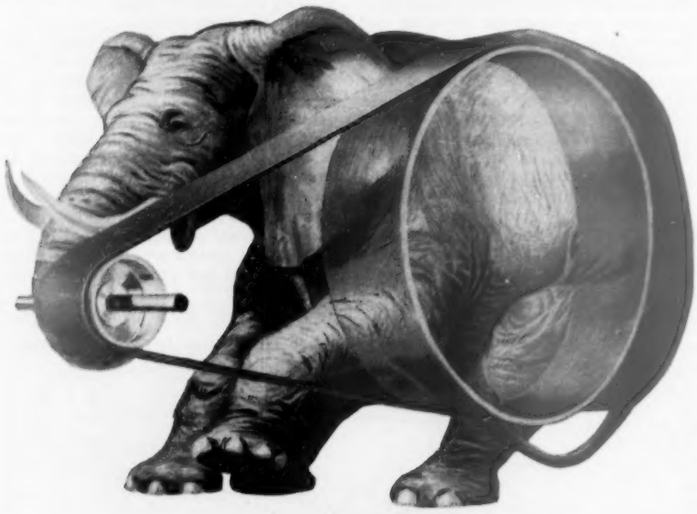

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future, there will be more mills and more efficiency, Mr. Heckmann said. In considering the future, he also noted two seemingly divergent trends —a trend toward smaller packages on one hand and bulk handling for larger users on the other hand. These trends, he said, could conceivably change methods of handling products, and at present there seems to be increasing use of fork trucks and pallets. With the increasing need for better working conditions and with more restrictions on nuisance conditions, a greater degree of dust control is indicated for the future.

With the increased use of trace ingredients, Mr. Heckmann continued, there will be more efficient and accurate proportioning equipment. Air handling systems will come into greater use, he also predicted. The advent of the terminal elevator for soft feed ingredients may mean a need of less storage space for these products at the mill. Actual building construction, Mr. Heckmann said, is not likely to change greatly from the present slip formed concrete construction. The number of man hours per ton will probably be about 1 or slightly less.

Leavening

(Continued from page 6a)

tralizing value is obtained by titrating to a pink phenophthalein endpoint in a solution which is nearly saturated with sodium chloride. Such a titration gives the amount of NaOH needed to convert from $Na_2H_2P_2O_7$ to $Na_4P_2O_7$. Sodium chloride is used in this titration so that the endpoint will be depressed to a pH sufficiently low to correspond to the phenophthalein color change. This test could be greatly improved by the use of an indicator which would change color at a considerably higher pH value.

Rheological Effects—The neutralizing value and the rate of reaction are not the only two variables which determine the effect of a leavening acid in actual baking practice. There are also significant differences between the various leavening acids (and, indeed, leavening agents in general) with respect to their action on the elastic and viscous properties of the dough. This is attributable in part to the well-known action of electrolytes on the mechanical properties of colloids."[5] Thus, the charge on the anions (phosphate, pyrophosphate, tartrate, etc.) plays an important role. In addition, there are specific interactions between the gluten and the ions of the leavening acids.

In general, it can be said that sodium aluminum sulfate weakens the gluten structure, whereas cream of tartar and the phosphates strengthen the gluten. Organic acids, as a class, give a soft dough. In the case of cream of tartar, the dough becomes soft, but at the same time the dough is not weakened, so that the evolved gas is not lost. The phosphates having fast reaction rates lead to thicker batters and doughs than do the slower-acting phosphates.

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Purification

(Continued from page 1a)

plus raw material quality and condition that provide for the right stock to be at the right place in correct quantities at all times. Seasonal and raw material changes are going to affect mill balance. Corrections must be provided based upon previous measurements or concepts.

Want to improve your purification? Check out your mill balance.

5. Flow. Demands upon production have always had some continuing effect upon the milling process. Production demands involving control of insect fragments, specification products, further extraction, ability to follow the market on both flour grades and by-products must be met by some change or adaptation of the milling process. Those changes must be followed deep into the process to result in a balanced, efficient operation.

Want to improve your purification? Check out your flow—ascertain that changes brought about by production demands have been followed through the process so that the flow is complete and effective.

All of this is rather a lengthy prelude to the principal subject of purification. Still, these items are so important in setting up the proper operation of the air purifier that they must be given good attention.

The Purifier

Now to consider the purifier.

All air purifiers, old and new, utilize the same basic principles. They separate on the basis that the greatest dissimilarity of the unlike materials in the streams of middlings are size, shape and specific weight. The purifier attempts to make a practical, if not absolute, separation on all three counts.

Thus, all purifiers are composed of a feeder to afford a smooth, uniform feed to the machine, a shaking sieve clothed more finely at the head and progressively more coarsely at the tail, air currents passing through the sieve against the fall of the stock, and a means of discharging the separates from the machine.

How well these items are applied and how accurately they are controlled represent the refinements that may make one machine more desirable than another. The problems of operation and points requiring observation are comparable.

Feeding. It is an absolute requirement that feeding must be accomplished in a smooth, even flow of stock fed across the entire width of the machine if the purifier is expected to perform correctly.

Many feeding problems have been solved on the new machines. It is worth while to spend some attention analyzing feeders in the selection of new machines. Look for good distribution, self regulation and accessibility for inspection and setting.

In the operation of older machines, feeders should be checked as to whether they are adequate and in good condition. In some instances, it will be determined that they are completely inadequate and will have to be replaced. Important, too, in the operation of the feeder is the manner in which spouting inlets are made and the distribution of the stock to the feeder.

If the only solution to feeder problems seems to be rebuilding or replacement, consider the use of a roll feeder. A feeder similar to the Nordyke roll feeder can be applied to many models of domestic purifiers.

There have been cases in which shaker feeders operating on choked feed cause interference with the motion of the purifier sieve. In this tolerance it is advisable to meter the purifier feed to the machine with a diamond slide or similar device in the spouting ahead of the machine. In this manner, the operating principle of choked feed and down machines is used, but the purifier actually operates on the stream.

Motion. The motion to the suspended sieve in the purifier is a combination of the work of the hangars and the eccentrics.

The problem of correct motion is not especially getting the original setting. True, it sometimes takes a lot of time and energy to get the correct motion and stock travel. The real problem, however, is maintaining that motion after it is established.

The enemy of the good sieve setting is wear.

If wear is recognized as the prime cause of changes in setting, a good operation demands some protection against it. What can be done?

First, in the selection of new machines, materials and techniques should be examined in which wear is minimized on driving mechanism and linkages.

In the operation of older machines, eccentrics can be modernized with anti-friction post and eccentric bearings, and links and pins can be replaced with hangars less susceptible to wear. Several types of hangars superior to the old links and pins are available: rubber bushed, cable, spring steel, etc. The rubber bushed hangars are usually fairly easy to apply.

Second, the motion of the sieve can be stabilized. The use of stabiliz-

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ers tends to lock the movement in position.

Most of the newer machines are equipped with some stabilizing method. In some instances, they are referred to as sieve tail control rods. In the selection of new machines, a point to observe is how stabilized the motion is against tail whip or side motion caused by the drag of the brush at right angles to the motion of the sieve.

Simple stabilizers may be applied to older machines. One method is to tie the sieve to the purifier frame with a ⅜ in. rod. The rod is connected to one side of the purifier frame at the tail of the machine and across to the opposite side of the sieve frame. The rod is threaded at its connection to the purifier frame so that sieve position may be controlled. Another method is the use of a ⅜ in. rod extending from one side to the other through the purifier frame. The rod is threaded on each end so tension and position may be controlled and attached to the sieve frame in the center.

With the use of single eccentrics or rubber bushed hangars it is sometimes advisable to use the stabilizer at the head as well as the tail of the machine. The stabilizing rods must be applied in such a manner that they permit lengthwise motion but prevent side motion.

The simple stabilizer can do a lot of good if it is used right. It should never be used to correct poor motion in the sieve. These corrections should be made with the hangars and eccentric driving rods. The stabilizer can then be used for hairline adjustment of sieve motion. Further, they are utilized to hold the correct motion once it has been established by correct setting of the sieve hangars and driving rods.

Sieve Conditions. To operate correctly the purifier sieve must be level and have the right slope from head to tail.

A common operational problem is at times due to a warped or twisted sieve frame. This problem is somewhat greater on the wider sieve domestic machines than with the narrower sieve utilized in European purifiers since a slight warpage, misalignment or out of level condition is accentuated by the wider sieve.

Warpage will be noted when checking the level of the sieve at head, center and tail. The practical solution is, of course, replacement of the sieve frame.

Alignment, level and slope (about 1 in. over the length of the machine) should be checked as cloths are serviced or changed. If alignment or slope changes, look for wear. If level changes, look for wear or warpage.

Air Distribution. The matter of proper air distribution is probably the greatest advance in the new purifiers available to the industry today. New machines use several methods of improving air distribution: small compartments with individual controls, larger compartments with tins to distribute and proportion air and separate air channels to the head, center and tail of the sieve. To attempt to analyze the merits of each method would be a subject unto itself. Certainly each is superior to merely having a fan in a chamber and expecting to properly distribute air from underneath the purifier sieve.

Improvement of air distribution in many of the older purifiers is limited due to the fundamental design of the machine. It is well to check the method of air inlet, however, to make sure it conforms as nearly as possible with the requirements for separation. The important point is that the air must pass through the sieve over which the stock is traveling with just enough force to carry away small bran particles without transporting any middlings. As nearly as possible, air inlet provisions should be for lighter air currents at the head and heavier at the tail.

In many instances, replacement doors have been made for existing purifiers with insufficient thought given to air inlet provisions. If such is the case, those provisions should be made.

Clothing. Improper clothing in many instances is the cause of improper purifier operation.

Some guidance can be obtained on clothing selection by test sieving the feed stocks. However, no formulas have been evolved that will provide for correct clothing combinations. Too many variables are involved to reduce this to a formula basis.

There are a couple of observations that will help in determining if clothing is in close balance to the operation.

First, are the head sheets bolting any stock?. In many instances the head sheets are so fine that purifier capacity is lost. The head sheets should be doing their job in releasing a portion of the load.

Second, is there any tailover when all air is cut off the machine? A tailover without air is an indication of clothing on the fine side. Purifier tailover should be the result of air application. Normal clothing is indicated when all stock bolts through the head end of the tail sheet when air is cut off the machine.

The minor changes necessary to obtain correct clothing requires good follow-up. If any advantages exist on the sectional purifier sieves of some machines, they are probably due to the more accurate clothing that is likely to be obtained because changes are more simple and less expensive.

Selection of Separates. Within the last decade, pressure to eliminate all insect harborage has resulted in the hoppering of a lot of purifiers. This has been a pretty good answer as far as eliminating static stock is concerned, but a lot of ability to inspect and select separates was lost when the conveyors and tips were eliminated.

In the selection of new equipment, this is a good point to bear in mind. The machine should have good provision to inspect and select the classifications the machine produces. Good answers are coming on this problem in the form of shaking conveyors and of specially designed and unique hoppers with tip selection. A good means of accurate selection of separates is essential to good purification.

* * *

As purification is associated with the process, consideration must be given to breaking, sifting, classifications, balance and flow.

As purification is associated with the air purifier, attention must be given to feeding, motion, sieve condition, air distribution, clothing and selection of separates.

Perhaps, as a result of having put a little milling thought into the subject of purification, we can do better with what we have or can better select what we need.

Here's why
COLD WEATHER
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There've always been several basic misconceptions about insect infestation during cold weather; also about cold-weather grain fumigant effectiveness.

It's frequently said: *(1) that grain insects become dormant or inactive in cold weather; (2) that, since the insects are dormant, they become resistant to fumigants; (3) that there's therefore little use in fumigating grain in cold weather.*

The trouble with the foregoing reasoning is that it begins with faulty assumptions and ends with false conclusions.

In the first place, the insects live in the grain. Hence their "weather" is the grain temperature. Cold weather has little to do with the internal temperatures of sizable bins of grain *unless* the grain is transferred.

Second, if infested grain is neither treated nor transferred, the insects are a worse threat in cold weather than in mild weather. Cold weather drives insects inward in an undisturbed grain mass. The insects instinctively "bunch". They thus create worse spot heating than in warm weather, often causing serious moisture condensation on adjacent surface grain.

Third, with their tendency to "bunch" and create warmth, insects don't become dormant in grain unless the grain temperature is below 60° F. *And how much grain have you ever had to treat in that temperature range?*

Fourth, while it's theoretically true that insects show increasing resistance to fumigant action as grain temperature is lowered, this isn't actually true—*not within the grain temperature range at which nearly all grain is fumigated.*

Fifth, it's actually the other way 'round. All fumigants are severely handicapped by high grain temperatures *accompanied by heating or poor grain condition* because such factors impede proper gas penetration, diffusion and sorption. But, with lower temperatures and proper grain condition, all fumigants benefit by more efficient action and increased sorption.

Below 70° F. the efficiency of fumigants containing slow-volatility compounds is supposedly lowered because of delayed vaporization. But the more effective and versatile liquid fumigants show increasing effectiveness down to a grain temperature of around 60° F.

Hence, don't be misled by the common cold-weather bogey about insect dormancy and fumigant ineffectiveness. More important, don't let it lull you into neglecting your grain. Infestation in untransferred grain is much more dangerous in cold weather. Don't be concerned whether your grain is too cool for effective treating. (It won't be.) Worry about whether it's too warm. If it is, run it and condition it. You can then fumigate effectively.

The above facts and conclusions have long been common knowledge to most elevator men having the widest experience in handling and treating large volumes of grain. The Weevil-Cide Company was merely the first to recognize, publicize and correlate the observed facts with the supporting technical background.

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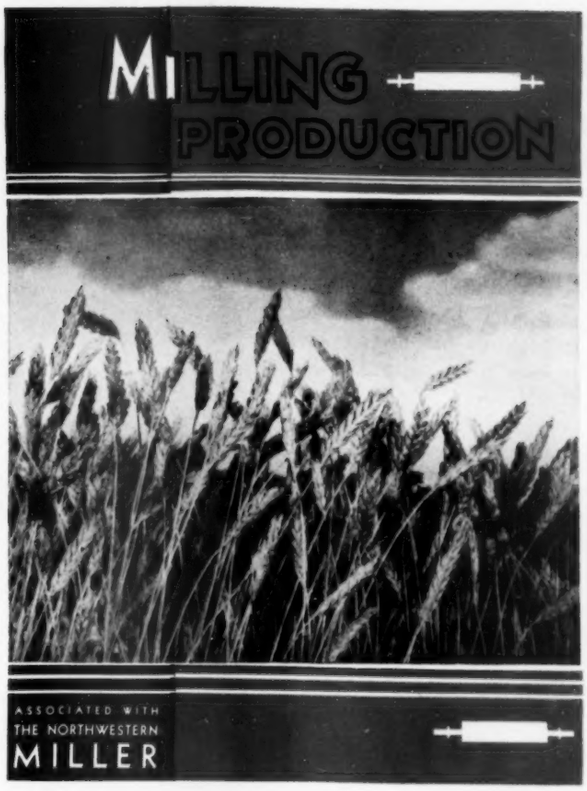

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